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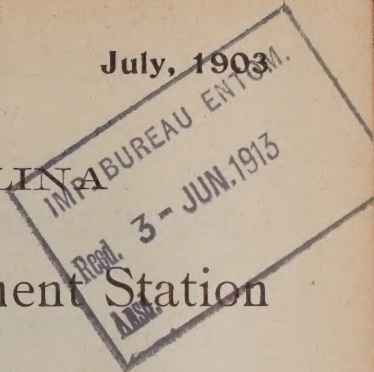
College of Agriculture and Mechanic Arts,

RALEIGH.

INSECT AND FUNGUS ENEMIES

OF THE

PEACH, PLUM, CHERRY, FIG AND  
PERSIMMON.



# N. C. COLLEGE OF AGRICULTURE AND MECHANIC ARTS.

## THE NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

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Visitors will be welcome at all times, and will be given every opportunity to inspect the work of the Station. Bulletins and reports are mailed free to all residents of the State upon application.

Address all communications to

THE AGRICULTURAL EXPERIMENT STATION,  
RALEIGH, N. C

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# INSECT AND FUNGUS ENEMIES OF THE PEACH, PLUM, CHERRY, FIG AND PERSIMMON.

BY F. L. STEVENS, BIOLOGIST, AND FRANKLIN SHERMAN, JR., ENTOMOLOGIST.

## I. Insect Enemies.

BY FRANKLIN SHERMAN, JR., ENTOMOLOGIST.

### a. INSECTS ATTACKING THE CHERRY.

#### 1. ATTACKING TRUNK OR BRANCHES.

THE FRUIT BARK-BEETLE (fig. 1).

(*Scolytus rugulosus*, Ratz.)

*Description.*—A small black or brown beetle, about one-tenth of an inch in length, which bores little holes through the bark into the sap-wood. Often they attack a tree in great numbers and tree dies from the attack.

*Life History and Habits.*—These insects do not usually attack a tree that is in good health. Their attacks are most often confined to

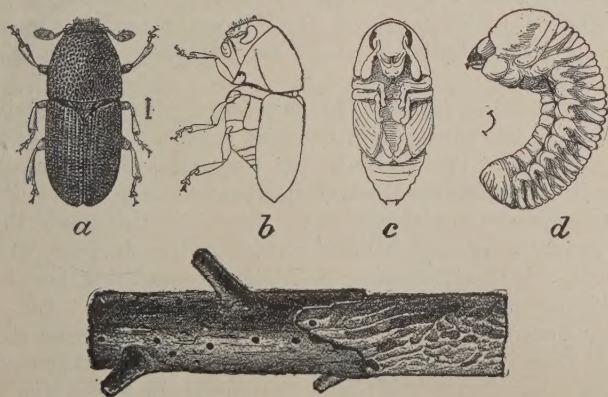


FIG. 1.—Fruit Bark Beetle.  
(After Chittenden, U. S. Dept. Agr.)

trees which have been injured by some other cause, as by lack of cultivation, or severe injury by storm, breaking of branches, etc. The

adult beetles bore into the bark and sap-wood and there deposit the eggs. The eggs hatch to tiny white grubs, which do still further damage by boring in the sap-wood, often to the extent of killing the tree. These little grubs finally become mature and transform to the pupa stage, from which the adult develops.

*Remedies.*—As already stated this pest does not usually attack healthy trees and the most important factor in control of the insect is to keep the trees in good health so that they will not be attacked. After the trees have been so neglected as to furnish a suitable place for these beetles, it is not surprising that they should quickly die when attacked. If a tree becomes thickly infested with them it had best be removed and burned without delay. If only certain branches are affected they should be removed and burned. Parts only slightly infested may be treated by rubbing them thoroughly with a rag saturated with pure kerosene in winter while the trees are dormant.

THE SAN JOSE SCALE (fig. 5).

(*Aspidiotus perniciosus*, Comstock.)

*Description.*—Very small insects of yellow color, the bodies of which are covered by a round grayish covering or scale. They attack the branches principally, but if the trees are young they may be on the trunk as well. When numerous, they so completely cover the bark as to render it of a grayish color, looking as if dusted over with ashes. The insects after becoming covered by the scale are incapable of movement, hence are not easily noticed.

*Life History and Habits.*—The life history of the insect is quite fully discussed under the head of "Insects Affecting the Peach," on page 12 of this bulletin. It is not necessary, therefore, for us to repeat it here.

*Remedies.*—Trees infected by this insect should be thoroughly treated during the winter with kerosene emulsion at the strength of 25 per cent oil. The formula for preparing this emulsion and reducing it to the desired strength is given in the Spraying Bulletin.

Cherry trees are so resistant to the attacks of this insect that they are not nearly so quickly killed by it as are peach, pear, plum and apple trees. In fact, we have seen cherry trees that had been infested for several years and which were still alive. But such a tree is a menace to other fruit trees around and therefore should be treated to keep it from spreading, if possible. One thorough treatment every two years will keep the insect in subjection on the cherry, though other infested fruit trees have to be treated every year. Trees which are to be treated for this pest should be well pruned before treatment, so as to effect a saving of the emulsion.



## 2. INSECTS ATTACKING THE LEAVES.

## CATERPILLARS, VARIOUS SPECIES.

Caterpillars are hatched from eggs which are laid by moths or butterflies. There are a number of kinds which may attack the foliage of the cherry, though it is not often that their injuries are serious.

*Remedies.*—When any species of caterpillar becomes destructive to the foliage of the cherry it may be easily subdued by giving the tree a prompt and thorough spraying with Paris green and water at the rate of one pound of Paris green to 150 gallons of water. Add as much lime by weight as is used of the Paris green. Stir the mixture thoroughly.

## LEAF-CHAFERS, VARIOUS SPECIES.

The insects to which the name of "Leaf-chafers" is applied are brownish or yellowish beetles which are especially numerous in spring and early summer and sometimes settle on cherry or other trees in great swarms, defoliating them by completely devouring the leaves. There are a great number of these beetles, all being more or less closely akin to the green June-bug with which we are all familiar. The beetles usually lay their eggs in grassy fields or pastures and the grubs which hatch from them live on the tender roots of the grasses. When fully grown these grubs change into pupæ, which in the course of a week or two transform into adult beetles which then proceed to lay eggs for another generation.

*Remedies.*—The spraying of trees with Paris green, lime, and water, as just mentioned for caterpillars, will prove efficient in killing these beetles. It is necessary to be very prompt, however, for the insects will often settle on the trees by thousands and do serious damage, even in a single night. They are nocturnal, beginning to fly after sunset.

## 3. INSECTS ATTACKING THE FRUIT.

## THE PLUM CURCULIO (fig. 6).

(*Conotrechellus nenuphar* Herbst.)

*Description.*—A dark gray or brownish beetle about 1-4 inch long, which scars or "stings" the fruit when young, laying an egg in each of the punctures in the fruit. The egg hatches into a white grub which bores through the flesh of the fruit to the pit. This causes the cherry to become soft and often rot, though they do not usually fall from the trees.

*Life History and Habits.*—These have been quite fully described under the head of "Insects Affecting the Peach," on page 17 of this bulletin.

*Remedies.*—If a grower has a number of trees and suffers considerable loss from this insect it will pay him to jar the trees in the spring of the year as is recommended for destroying this pest on peaches on page 18 of this bulletin. When there are only a few trees or if they are very large this is hardly worth while or practicable, in which case nothing better can be done than to spray the trees at least twice with Paris green, lime and water; First, as soon as the leaves are about half expanded; Second, ten days later. Use at strength of 1 ounce Paris green to every 10 gallons of water, adding as much lime by weight as is used of the Paris green, and stir the mixture thoroughly.

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## b. INSECTS ATTACKING THE FIG.

### 1. ATTACKING THE FRUIT.

#### THE FIG-EATER, OR JUNE-BUG.

(*Allorhina nitida*, Linn.)

*Description.*—A greenish beetle nearly an inch in length, which flies with a loud buzzing sound, which sometimes eats the ripe fruit of the fig. Familiar to us all under the name of "June-bug."

*Life History and Habits.* The June-bug lays its eggs in grassy lands or pastures and the eggs hatch into white grubs. When gardens or strawberry beds are planted directly in sod land they are apt to be infested with white grubs, which were feeding on the roots of the grasses. It takes the grubs two years to reach maturity, when they transform into pupæ, which then change again into beetles which lay the eggs for another generation.

*Remedies.*—The only remedy thus far known to use against this beetle when they attack the fig is to jar them from the bushes and kill them.

It seems that the insect must not do much damage to the fig in this State, for we have had no report of injury by it in over two years. We mention it as it is recorded in other works as an enemy to the fig. We should be interested to hear from any who suffer from the attacks of this insect on the fig.



## c. INSECTS ATTACKING THE PEACH.

*General Remarks.*—While the insect enemies of the peach are not so numerous as those of the apple, yet the peach probably suffers even more if these pests be neglected. The peach tree is a tender plant, easily hurt by neglect, frosts, fungi or insect enemies. It is often extremely difficult to treat peach trees for certain pests, as they are so tender that an application which will kill the pests may also injure the tree. Skill, care, promptness and thoroughness are therefore essential in treating this tree for insect enemies, and even the least carelessness will often cost the life of the tree. Even with the best of care the results are often very imperfect.

## 1. ATTACKING TRUNK OR BRANCHES.

## THE PEACH TREE BORER (fig. 2).

(*Sannina exitiosa*, Say.)

*Description.*—White “worms” which bore into the bark and sap-wood of the tree at the surface of the ground, causing a large amount of gum to appear at the injured part. Often they completely girdle the tree, thus killing it.

*Life History and Habits.*—The Peach Borer, as we commonly know it, is a sort of “worm.” These are hatched from eggs which are laid in summer from June to October by a female moth. This moth flies by day and very much resembles a wasp in appearance, being of a steel-blue or black color marked with a yellow band around the body. The eggs are deposited on the trunk of the peach trees at the surface of the ground and hatch into the white caterpillar, which bores in to the bark and lives in the inner bark and sap-wood. They become fully grown in spring and leave the tree and spin a silken cocoon on the outside of the tree or a few inches away in the earth. Within the cocoon the caterpillar passes through the transformation to the adult moth which then emerges, mates and lays the eggs for another generation.



Male.

Female.

FIG. 2.—Peach Tree Borer.

(After Riley. 1. Missouri Report.)

*Remedies.*—To successfully combat this pest the fruit-grower must be thorough and persistent in his work against it. In early spring (March is the best month

for the greater part of North Carolina) the trees should be gone over carefully and all showing signs of the borers should be “wormed.” The gum and rough bark at the base of the tree is scraped away

and one or two inches of the earth removed. With a stout knife probe about and kill every worm which can be found. After the tree has thus been freed of the worms hill the earth up against the base for four or five inches above the normal level, so that the moths will have to lay their eggs higher on the trunk of the tree. This mound is left until December, when it is removed again so that the worms will be exposed to the cold of winter. Then in March the trees are wormed and mounded again as before.

By this means the moths are compelled to lay their eggs higher on the trunks of the trees and thus they are easier to reach and kill. In addition to this, many of the young worms will not be able to bore into the rough bark on the trunk and will perish.

*Special Note.*—There is a little, slender white worm, *without a distinct head*, which lives within the gum which exudes from the base of the peach tree. These are not the borers and have nothing to do with them, and they do not injure the tree. The Peach Borer is rather a stout-bodied worm with a very distinct brown head.

#### THE FRUIT BARK-BEETLE (fig. 1).

(*Scolytus rugulosus*, Ratz.)

*Description.*—Small black or brownish beetle, about one-tenth of an inch in length, which bores little holes through the bark into the sap-wood. Often they attack a tree in great numbers. Little drops of gum exude from the holes made by these insects in peach trees.

*Life History and Habits.*—These have been sufficiently explained under the head of "Insects Attacking the Cherry," on page 5 of this bulletin, so that no further discussion is needed here.

*Remedies.*—The remedial measures recommended for this insect are described on page 6 of this bulletin.

#### THE PEACH TWIG-BORER (figs. 3 and 4).

(*Anarsia lineatella*, Zell.)

*Description.*—Small pink or reddish caterpillar with black head, which bores into the tender growing shoot in spring about the time the leaves are becoming expanded. Kills the young twig for several inches. Often enters at base of a bud or young shoot.

*Life History and Habits.*—The little caterpillar which does this damage is hatched from an egg laid by a moth. The moths of the Peach Twig-borer are shown in the accompanying figure. The life history of the insect as it exists in the Eastern and Southern States is not well known. When fully grown the larva spins a thin web

in the dried leaves or rubbish in the twigs of the tree, or near it on the ground. There it changes to the pupa (as shown in the figure) and from this the adult is developed. There are thought to be two broods of the insect each year.



FIG. 3—The Peach Twig-borer. *a*, work of the larva in growing shoot; *b*, larva, which does the injury; *c*, the pupa into which the larva transforms.

(After Marlatt, U. S. Dept. Agr.)

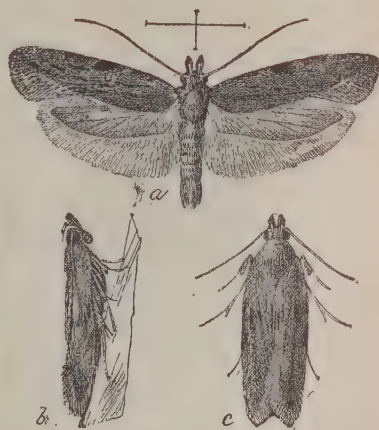


FIG. 4—The Peach Twig-borer. *a*, adult moth with wings spread; *b*, view of moth from side; *c*, view of moth from above.

(After Marlatt, U. S. Dept. Agr.)

*Remedies.*—The most commonly used and most satisfactory method of dealing with this pest is simply to clip off the withering shoots as soon as the injury becomes apparent and burn them. In this way the larvæ within the twigs are destroyed.

#### LECANIUM—SCALE-INSECT.

*Description.*—Scale insects which are of soft consistency, the scale not being distinct from the body. They are nearly hemispherical in shape and brown or yellowish in color. Only the young insects crawl about, the older ones remaining attached to the bark.

*Life History and Habits.*—The only complaint of *Lecanium* on peach in this State has come from Buncombe county, but as the writer knows that it is quite injurious in Western Maryland, where the conditions of soil and climate are quite like those of Western North Carolina, it is worth while for our peach-growers in the west to be on the watch for it.

The full-grown *Lecanium* scales are about one-eighth of an inch in length (and are very convex, having the appearance of little brownish knots or galls on the twigs. Like most scale-insects they are attached to the bark, so that they do not crawl about, only the young insects being able to move from place to place. The young



insects after crawling about for a few hours insert their little beaks into the bark and begin to suck the sap. Then the outside covering of the body becomes hardened and they shed off the skin with the legs, so that they thereafter are incapable of moving about. They are very easily rubbed from the bark or crushed, and when crushed they give an odor which (to the writer) is nauseating, though this odor is not very strong.

*Remedies.*—The Lecanium is very easily controlled by spraying during the winter with kerosene emulsion at the strength of 15 or 20 per cent oil. Full directions for preparing this emulsion are given in the *Spraying Bulletin*.

The treatment should be made during winter when the trees are dormant. One thorough treatment will so check the pest that it will not again become destructive for several years. In using the kerosene emulsion on peach trees be careful not to allow it to run down the trunk and in at the roots. Only use just enough to thoroughly dampen all the bark.

#### THE SAN JOSE SCALE (fig. 5).

(*Aspidiotus perniciosus*, Comstock.)

*Description.*—A small yellowish-colored insect, which is covered by a circular, flattened, grayish covering or scale. The insect attacks the branches of trees, often also on the trunk, especially when the trees are young. When a tree is badly infested the scales may be so thick as to overlap one another, covering the bark completely and giving the tree a grayish appearance as if dusted over with ashes. Attacks most deciduous fruit trees, but is seldom found on forest trees. Keiffer, LeConte and Garber pears are seldom attacked.

*Life History and Habits.*—The San Jose Scale has been the cause of much alarm among fruit-growers, and indeed, it is a serious pest if left to run its course in an orchard. But it can be kept in control if the proper remedies are thoroughly and regularly applied. We give quite a full account of this insect. The scale itself (which is all that is visible as it exists on the tree) is separate from the body of the insect. The insect lies directly beneath the scale, and is of a yellow color, closely resembling a small bit of cheese or butter. The scale of a full-grown female insect is about as large around as a good-sized pin-head. When the insects are thick and crowded on a twig the scales do not attain so large size. Beneath this scale the insect lies, with its slender beak thrust into the bark, sucking the juices. The females give birth to living young which are so small, as to be barely visible to the naked eye. When first hatched the young insects are able to crawl about, but after a few hours they,

too, insert their beaks into the bark to suck the sap. After once inserting the beak they do not remove it, but remain attached at that spot. Soon the skin is shed, and with the skin the legs and antennæ (feelers) are also lost. The shed skin helps to form a covering over the body, which is added to from time to time, becomes harder, and is the *scale* which covers the insect. In the figure the insect will be seen depicted in various stages of growth. Near the upper end of the figure are some of the young crawling lice. The small, round,



FIG. 5.—The San Jose Scale. *a*, appearance of infested twig, natural size; *b*, appearance of infested twig under magnifying glass.

(After Howard and Marlatt, U. S. Dept. Agr.)

light-colored objects are those over which the scale is just forming, while the larger, round, blackish or grayish ones are the half or full-grown scales.

The development of the two sexes is different. Near the upper left-hand corner of the figure will be noticed two scales which are oblong in shape. These are scales of male insects. The largest circular scales are of females. The smaller circular scales are of partly-grown individuals. The male insect finally develops into a tiny yellowish fly, which escapes from beneath its scale. The female insect always remains under the scale and never regains the

power to move about after once settling down on the bark to feed. From the time of birth it takes the males about four weeks to come to full maturity and a little longer for the females. The number of young brought forth at a birth is variable, but usually runs from about six to thirty. Hence it is easy to see that if left unchecked it will soon be so numerous as to kill the tree.

The young insects can not settle down well on old tough bark, as they need to find tender bark which they can pierce with their delicate beaks. Hence if a tree be already old before it is attacked it may not be killed, though the tender growth would doubtless be hurt and the insect could spread from such a tree to others. But if they get on a tree while it is young and the bark tender, they may locate anywhere on the trunk or branches, and if not discovered and promptly treated, they are likely to kill the tree. We often receive twigs which are more thickly infested than that shown in the figure.

In winter the full-grown insects usually die, leaving only the half-grown individuals alive in the spring. But in the warmer sections of the State, and especially in warm winters, the adult insects may live through the winter.

The breeding season begins with the first warm weather of spring and continues until freezing weather in the fall. The exact time of course depends upon the season. In 1902 they began breeding in middle of March in the middle section of the State, and were likely breeding earlier in the eastern section.

The insect can not spread much of its own accord, hence is dependent upon other agencies to get from place to place. It is only when young and crawling that they can be detached from one tree and transferred to another. If the branches of two trees touch, of course the young insects may crawl from one to the other. But for the most part they are dependent on forces outside of themselves. A breeze may blow gently through an orchard and carry the tiny young lice, like particles of dry dust, from one tree to another. In most infested orchards it is noticeable that it spreads most rapidly in the direction with the prevailing winds. Or, a bird may alight in a tree and some of the young lice crawl on its feet or feathers. Then it may fly away into some other tree or orchard where the young insects may become established. Thus it is not possible to tell how far the pest may be carried from an infested orchard. If the country be level and cleared so that wind has free play over the orchards the spread is likely to be fast. On the other hand, if the country is broken and there is much woods intervening between orchards, it will spread more slowly.

Another means by which the scale may be spread is by the sale of nursery stock. A nurseryman may have scale in his nursery and not know it, and thus he may unknowingly do his customers



great injury. It is for this reason that the law requires the nurseries of the State to be inspected each year, and our nurserymen are now introducing the practice of fumigating all of their fruit trees with a poisonous gas before shipping them, so as to kill any insects which may be on them. But of course this does not prevent the scale from attacking them afterward, so that the grower himself must be watchful and careful.

We are often asked how long it will take the San Jose Scale to kill a fruit tree. Of course it will depend upon the kind of tree and how old it is when it becomes infested. If the tree becomes infested as soon as budded, peach and plum are likely to die within from one to two years; apple, pear and cherry in from two to four years. If infested when five years of age, peach and plum will usually die in three or four years, pear in four or five years, and cherry and apple in four to six years, or perhaps not at all. If a tree is free from scale until eight years of age or older, our observation has been that apples are not likely to be killed outright, though peaches and plums may. Of course an infested tree should be regularly and thoroughly treated, whether it is weakened or not, for otherwise it becomes a center from which the scale may spread to other trees or orchards in the vicinity. Furthermore, though a tree may be too hardy to be killed outright, yet the younger branches where the fruit should be borne, may be injured to such an extent that the tree can not mature the crop. If an infested tree is not treated every winter it is liable to be seriously hurt, therefore *those who have infested trees may count on treating them once thoroughly each winter, no matter how thoroughly they may have been treated before.*

At the present time (October 1, 1903), this pest is known to exist in orchards in thirty-five counties of the State; these including Surry, Person and Halifax on the north; Halifax, Bertie, Carteret and New Hanover on the east; New Hanover, Scotland and Gaston on the south, and Jackson, Haywood and Mitchell in the west. We can see, therefore, that it is not limited to any portion of the State, and trees in any section may be infested. At present we know of no case of scale to the east and north of Bertie, Pitt and Carteret counties, but there can be but little doubt of its presence there, even if we have no record of it. New cases are being brought to our notice almost every week. Every grower must, therefore, be watchful, and should at once send to this office any twig which he suspects of being infested with this scale.

*Remedies.\**—The remedy used for this pest is kerosene emulsion

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\*The writer of this article has a special circular relating to treatment for this pest, which will be sent to any one on application. Address FRANKLIN SHERMAN, JR., Entomologist, Raleigh, N. C.

at the strength of 20 per cent oil. Directions for making the emulsion are given in the Spraying Bulletin. The applications can best be made with a spray pump, but if one is not to be had, the remedy may be applied by hand with a brush or rag, if trees are not too numerous.

This remedy can only be applied to trees in winter when they are in a dormant state, and should be applied in fair weather. If applied after the buds have burst it is likely to do very serious injury. If any trees are so badly infested as to make it impossible to save them they should be dug up and burned on the spot, as soon as the trouble is discovered. All other trees that are infested (no matter how slightly) should be marked for treatment the next winter.

Only just enough of the emulsion should be used to thoroughly dampen the bark of the tree. It should not be allowed to run down the trunk and in at the roots. But remember that the application will only kill those insects that are actually touched by it, so that the object should be to dampen every square inch of the surface of the bark.

It is very desirable to trim trees before treating them for this scale, so that it will be easier to reach all the parts and also so that it will not require so much of the material. In any case, those who suspect that their premises are infested are urged to send twigs to this office, together with full information as to the number of trees in the orchard, the number found infested, the age of the trees, and from whom they were purchased. We will then be able to advise more fully and more intelligently.

## 2. ATTACKING THE LEAVES.

### BLACK PEACH APHIS.

(*Aphis prunicola*, Kalt.)

*Description.*—Small reddish or brownish, soft-bodied, louse-like insects, which sometimes appear in great numbers on the buds in very early spring, sucking the sap from them and often causing them to die.

*Life History and Habits.*—The life history of this insect is not fully known, and this account is taken from another publication.\*

The insect is also found on the roots where it breeds undisturbed. In the spring it makes its appearance at the surface of the ground, where it establishes itself on the new shoots. Here a form is developed which has wings, which fly to other trees and start new colonies. They feed until about midsummer and work their way down to the roots.

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\*Bul. No. 48, Md. Agr'l Exp. Station, p. 98, by W. G. JOHNSON.

*Remedies.*—The pest can be easily destroyed by spraying with kerosene emulsion at 15 per cent oil, but care must be taken to use no more than is necessary to dampen the affected shoots, and it should not be allowed to run in at the roots. A very thorough dusting with tobacco dust will also prove very beneficial. The insect is not commonly destructive in this State, but has done damage in some years. Formula for preparing the kerosene emulsion and diluting it are given in the Spraying Bulletin.

### 3. ATTACKING THE FRUIT.

#### THE PEACH AND PLUM CURCULIO (fig. 6).

(*Contotrechellus nenuphar*, Hbst.)

*Description.*—A small brownish beetle, with rough wing-cases, quite hard, so that it requires considerable pressure to crush it, which cuts scars in the young fruit, laying the egg in the puncture. This egg hatches to the “worm” which is so often found in peaches and plums.

*Life History and Habits.*—The adult insects appear in very early spring, about the time that the leaves on the peach and plum trees expand. They feed to some extent on the leaves. About the time the blossoms fall from the fruits they begin to deposit the eggs. A scar, usually in the shape of a crescent, is cut in the flesh of the young fruit, and in front of this crescent a hole is punctured. The egg is then laid in this hole. The adult beetles die shortly after. The egg hatches to a small white grub which bores directly through the flesh of the peach to the pit, where it feeds until it reaches maturity. This causes the peach to be soft, and often rot and fall before ripening. When the grub is fully grown it leaves the fruit and to the adult beetle, which again provides for the succeeding generation and dies.

It seems that in this State the adult beetles pass the winter in sheltered places in woods, probably under bark. Trees standing near wood lands seem to be attacked first in the spring and the injuries seem to be more severe than on those further into the orchard which are more removed from the woods. This seems to be the universal experience in the large commercial orchards at Southern Pines.

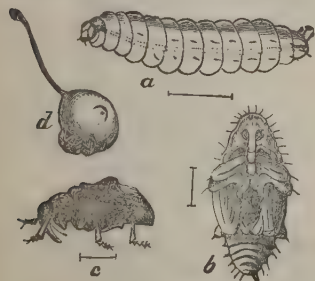


FIG. 6—Plum Curculio. a, grub; b, pupa; c, adult beetle; d, adult on young fruit, showing the scar made by it.

(After Riley. Missouri Report.)



This insect, with the Peach-borer and San Jose Scale, are the three most serious insect enemies of the peach in this State, and as Curculio and Borer are present in all orchards, we are inclined to place them in the first place so far as their damage in the State as a whole is concerned. But in those orchards where the scale has secured a foot-hold, we believe that it is even more destructive, as the neglect of one or two years (in a young orchard especially) means a loss of many trees.

Like many other insects, the adult beetles of the curculio have the habit of dropping quickly to the ground and remaining motionless ("playing 'possum") when they are disturbed, and this habit is made use of in combatting them.

*Remedies.*—Jarring the adult beetles from the trees into sheets is the best method yet discovered for the control of these beetles on the peach. After being thus collected the beetles are crushed with the fingers, burned or killed by pouring into a pan of kerosene or similar material.

The peach-growers at Southern Pines have developed this practice to a fine art, and other growers who will follow the same method will surely find it profitable. Two men are engaged in the operation. Each is provided with a frame upon which is stretched a sheet, the whole forming a half circle. This is made large enough so that two of them placed together will cover the entire space under a tree, and the frames are hung by straps from the shoulders of the men. The men walk along the row of trees on opposite sides, bringing the frames together under each tree as they go, and giving it a few smart blows with a heavy stick which is wrapped with an old sack so as not to bruise the bark. After jarring from one to twenty-five trees in this way they stop, lower the frames to the ground and crush the beetles with the fingers. The insects are naturally rather sluggish and do not fly readily when jarred from the trees, but crawl slowly about, or lie still on the sheets. They are more active, however, later in the day and for this reason it is best to do this work in early morning. The best growers begin the work by six or seven in the morning (as soon as the hands come) and stop at ten or eleven. Each tree should be jarred at least three times each week from the time the fruit "sets" until it is half-grown.

*Special Note.*—There will be many hundreds of insects jarred from the trees which are harmless or beneficial. Of course it is only desired to kill the beetles that actually do the damage, therefore every grower should be familiar with this pest. A study of the figure will aid in recognizing it. Fruit-growers should also observe closely and see if they can detect the beetle in the act of scarring the fruit, so that they may know the culprit at first hand.

There is another important point to remember. The egg of the curculio hatches into a *grub* and not into a small beetle. When the grub finally matures to the beetle it is full-grown when it comes out as a beetle. There is, therefore, no such thing as "young curculio beetles, which are smaller than the grown ones," as some seem to think. All of the curculio beetles are approximately the same size and of exactly the same shape and appearance. Any other beetles which may be jarred from the trees are of other species, which need not concern us.

#### BEES.

(*Apis mellifera*, Linn., and others.)

Bees have been twice reported to us as destroying the ripening fruit of peaches. There is no doubt that they do considerable damage in this way, but as a usual thing their attacks are more frequent on over-ripe fruit. They are seldom to be regarded as pests when the fruit is picked and shipped promptly when in shipping condition. It is, therefore, more often complained of in family orchards, where the fruit is purposely allowed to become as ripe as possible before picking.

*Remedies.*—The remedies to be used in this case must be purely mechanical for the bees are valuable property to their owners and so should not be destroyed. They are also very efficient in producing fruit by carrying the pollen from one flower to another, and thus probably repay many fold for all that they destroy.

Valuable trees might be covered with cheap mosquito-netting when the fruit begins to ripen. Also the fruit may be picked before it becomes fully ripe and kept indoors to mellow. A further suggestion is that some kind of tree or flowers might be planted near the hives or the orchard which would be especially attractive to the bees at the time the fruit is ripening, so as to induce them to leave the fruit alone.

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### d. INSECTS ATTACKING THE PERSIMMON.

#### 1. ATTACKING THE TRUNK OR BRANCHES.

##### THE TWIG-GIRDLER.

(*Oncideres cingulata*, Say.)

As the cultivation of the persimmon becomes more extended the work of this insect will probably become more noticeable and attract attention. At present no reports of damage by it have been received, but its work has often been noted on our common wild persimmon trees.

*Description.*—A grayish beetle with antennæ as long as the body, which gnaws around the twig so as to girdle it and cause it to drop easily.

*Life History and Habits.*—The injury done by this insect is incidental to egg-laying. The female deposits her egg in a little hole in the bark and then gnaws around the twig at a place *below* where the egg is laid. This cuts off the circulation of the sap and causes the twig to wilt and die. The grub which hatches from the egg burrows within the twig and feeds upon the drying wood and fermenting sap. When a heavy wind or storm breaks off the twig the grub falls to the ground with it. There it completes its growth and transforms to the *pupa*, all the time remaining within the twig. The pupa develops to the adult beetle, which gnaws its way out of the twig and escapes, when it proceeds to provide for the next generation.

*Remedies.*—A very simple and effective means of keeping this insect in control will be to gather and burn the fallen twigs so as to kill the developed insects within them.

## 2. ATTACKING THE LEAVES.

### THE FALL WEB-WORM (fig. 7).

(*Hyphantria cunea*, Drury.)

This insect is quite fully described in Bulletin No. 183, under the head of "Insects Attacking the Pear."

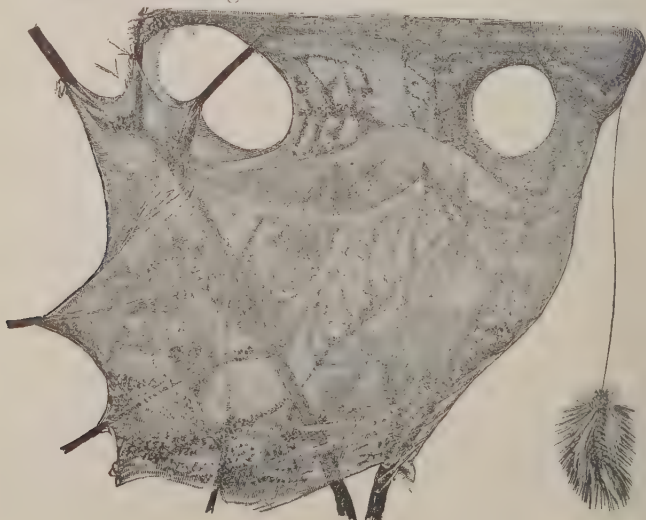


FIG. 7.—Fall Web-worm.  
(After Howard, U. S. Dept. Agr.)



*Remedies.*—At any time that this pest should become destructive the nests may easily be cut out and burned with their occupants. As these caterpillars do not leave the nest to feed, at any time that the nests are gathered the insects will be in them. But when about grown the caterpillars desert the nest, therefore the nests should be gathered and burned without undue delay after they make their appearance.

A spraying with Paris green in water at the rate of 1 ounce of green to 10 gallons of water would also be effective, especial attention being paid to the leaves closest to the nests.

## c. INSECTS ATTACKING THE PLUM.

### 1. ATTACKING THE BRANCHES.

THE FRUIT BARK-BEETLE (fig. 1).

(*Scolytus rugulosus*, Ratz.)

This insect has already been sufficiently described on pages 5 and 10 as an enemy of the peach. The same remarks there made will apply here, both with regard to its habits and as to remedies to be used.

### LECANIUM—SCALE-INSECTS.

There is at least one species of Lecanium that attacks the plum in this State. This species is probably different from that described on page 11, but all the remarks there made as to remedies may be followed when the plum becomes likewise infested.

THE SAN JOSE SCALE (fig. 5).

(*Aspidiotus perniciosus*, Comstock.)

This famous pest has been very fully discussed as an enemy of the peach, to which tree it is, if possible, even more destructive than to the plum. The discussion will be found on pages 12-16. We have found, however, that the Wild-goose Plum is apparently not injured by the scale, which is worthy of note.

*Remedies.*—The remedies as recommended for the peach may be likewise applied to the plum, using the same precautions.

### 2. ATTACKING THE LEAVES.

THE BLACK PEACH APHIS.

(*Aphis prunicola*, Kalt.)

This insect, which is discussed on page 16 as an enemy of the

peach, is not infrequently also found on the young leaves of the plum, where it may do serious injury.

*Remedies.*—The remedial treatment suggested on page 17 will be followed when the insect attacks the plum.

#### LEAF-CHAFERS—various species.

There are various species of beetles which belong to the group of Leaf-chafers, which are liable to appear in great numbers at times, especially in the evenings, and devour the foliage. This occurs as soon as the leaves come out, for the beetles become mature at that season. We have had report of such injury in March, from Moore county, in which case the insect responsible was *Anomala undulata*. Various beetles of the genera *Anomala* and *Lachnosterna* are liable to do this injury.

*Remedies.*—If the grower makes a practice of spraying in the spring with Bordeaux Mixture and Paris green these beetles will be killed when they attack the tree, even though they may sometimes be present in such numbers as to defoliate the tree in spite of that protection. If they be detected as soon as they begin to swarm around the tree they may be combatted by immediately bringing out the spray pump and spraying the tree with Paris green and water at the rate of one ounce of green to eight gallons of water. This work should be done the very hour that the beetles are noticed damaging the trees—if they are present in sufficient numbers to do serious injury.

#### CATERPILLARS.

There are only a few species of caterpillars which do serious damage by eating the leaves of the plum. These caterpillars of course hatch from eggs that are laid by butterflies or moths (mostly by the latter), and they finally develop to that stage.

Orchards that are sprayed in the spring when the leaves are first expanding, with the Bordeaux Mixture and Paris green, are not troubled by these caterpillars. If they should at any time become numerous enough to be serious, they may be killed by spraying the trees with Paris green and water at the rate of one ounce of green to ten gallons of water.

### 3. ATTACKING THE FRUIT.

#### THE PEACH AND PLUM CURCULIO (fig. 6).

(*Conotrechellus nenuphar*, Herbst.)

This pest has been quite fully discussed as a pest of the peach on page 17. All the points there brought out will apply equally well when the insect attacks the plum, including the remedies suggested.

## II. Fungus Enemies.

BY F. L. STEVENS, BIOLOGIST.

### a. FUNGUS DISEASES OF THE PEACH.

#### THE RUST.

(*Puccinia.*)

A true rust exists parasitically upon the peach and its relatives, the plum and cherry. (See Fig. 53, Bull. 92, of the North Carolina Experiment Station.) While more common upon the plum, it very frequently does damage to the peach, in some cases being so serious as to cause almost complete defoliation.

This malady will be recognized by the presence of small, round, dusty spots on the lower surface of the leaves and on the young shoots, while in the immediate region of these pustules the tissue, seen from above, often turns to a reddish or reddish-yellow color. It is in these pustules that the spores are borne, the mycelium of the rust fungus running through the tissue between the two surfaces of the leaf.

*Treatment.*—Evidently no treatment can reach the mycelium of the fungus without doing damage to the leaf itself. Reliance, therefore, must be placed in prevention. It is probable that enough spraying of the tree, such as is recommended for the peach curl and the mold, will to a great extent lessen the effect of the attack of the rust, inasmuch as the spores that winter over on the tender twigs and upon the bark of the tree will be thus killed or their germination inhibited.

#### THE MILDEW.

(*Podosphaeria.*)

There is a mildew on the peach very similar to the powdery mildew of the grape, cherry, lilac, and rose. It sometimes becomes so abundant as to almost completely ruin the crop, attacking the leaf and twig. When on the fruit, it appears first while the peach is small, causing irregular grayish blotches. These enlarge, and cracking often results. On these patches the summer spores, which serve to spread the disease to new tissues, are produced in great abundance. Some of these spores pass the winter on the surface of the bark, there awaiting to accomplish the spring infection.

*Treatment.*—The winter treatments recommended for both the peach curl and the brown rot, or mold, will be effective in killing these wintering spores, and will thus largely diminish the injury from this pest.



## THE STEM BLIGHT.

*(Phoma.)*

Sometimes twigs die from the attack of a fungus on the bark. The fungus fructifies in minute pimples, which are filled with spores. The disease may be readily recognized by the dead bark thickly infested with small pimples. Burning of the diseased branches will prevent the spread of the pest.

## THE CURL.

*(Exoascus.)*

This disease is distributed throughout the peach-producing region, being particularly abundant in the more moist localities. It has been estimated that the annual loss caused by it amounts to approximately three million dollars in the United States.



FIG. 11—The Peach Curl.

The disease is due to a fungus which grows in the leaves, causing the peculiar malformation which justly gives rise to the popular name of *curl*. This fungus destroys the utility of the leaf as a

starch-producing organ, and eventually causes defoliation, and thus direct loss to the trees. This loss may be manifest in two ways: First, by the present effect upon the vitality and vigor of the tree, and immediate injury to the crop; second, by a weakening of the tree in succeeding years, due to the lack of full nourishment during the period of attack. The injury in the present year, manifest by a loss in productiveness, is obvious to the grower. The injury in succeeding years, often fully as great, is often overlooked, or is not attributed to its true cause.

It was formerly thought that the mycelium of this fungus persisted in the twigs over winter, and thus lurked ready to infect the new leaves as they began to develop. It has, however, been proved that nearly all spring infection is due to spores which remain on the bark of the trees and not to perennial mycelium.

*Treatment.*—The mode of attack, then, in the prevention of the disorder is, obviously, to kill these spores by winter spraying. For this purpose the Bordeaux mixture, or a simple copper sulphate solution, is efficient. In many ways the Bordeaux is more satisfactory than the copper sulphate solution. It does not have a strong corrosive action upon the pump. It is easily seen upon the trees, and consequently it is not difficult to determine when a thorough application has been made. There is probably little choice between these two solutions on the ground of efficiency. The spraying should be made from one to three weeks before the buds open in the spring, and thoroughness is the chief point desired. Spraying should be done in dry calm weather, during the middle of the day, in order to avoid dew or frost upon the limbs.

Mr. Newton Pierce, in Bulletin 20 of the Division of Vegetable Physiology and Pathology, states as an experience in California, that in the treatment of the peach curl, from 95 to 98 per cent of the spring foliage was saved by spraying. A net gain of 600 per cent in the foliage over that retained by adjoining unsprayed trees resulted in the case of several different sprayings. The Bordeaux mixture, when applied to the dormant tree, increased the weight and starch-producing power of the leaves, and the sprayed trees showed a great gain over the unsprayed in the number and quality of the fruit buds they produced for the following year, the gain in the number of spur buds being over one hundred per cent in some cases. The lower limbs of sprayed trees showed a marked gain over those of unsprayed trees as compared with the upper limbs in both the number of the fruit buds and lateral shoots they produced. The sprayed tree also produces more vigorous growth of new wood, the wood to produce the crop for next year. Thus, in one experiment the spring growth of the unsprayed tree averaged 7.85 inches; on the sprayed trees it was 24.75 inches. The importance of this is obvious.



FIG. 12.—Treated and untreated Crawford's Late Trees. (From Pierce, U. S. Department of Agriculture.)



The average value of fruit per tree in rows treated with the most effective Bordeaux mixture ranged as high as \$6.20 above that in adjoining untreated rows, or the equivalent of a net gain of \$427.80 per acre where trees are planted 25 by 25 feet. Over *one thousand* per cent net gain in the fruit set has resulted in the use of some of the more effective sprays.,

The trees should be sprayed each season, since the experiments prove that treatment one season will not prevent the disease the following year. Spraying should be done, even though the trees are not expected to bear, since the loss of the crop of leaves is shown to be as great a drain upon the trees as is the maturing of one-half to two-thirds of a crop of fruit.

All peach growers should apply to the Department of Agriculture for Bull. 20 of the Division of Vegetable Physiology and Pathology, which give a full discussion of this subject.

#### THE CROWN GALL.

(*Dendrophagus.*)

There is a malady of the peach, plum and almond trees which manifests itself by the production of conspicuous galls at the crown of the tree, while the general health of the tree and its productiveness becomes seriously affected. Very similar abnormal growths and symptoms likewise occur on numerous other trees: namely, the apple, pear, English walnut, grape, raspberry, blackberry, cherry, poplar and chestnut, as well as upon the apricot and prune, which are close relatives of the peach and plum already mentioned. Experimental evidence seems to indicate that the gall of the peach, plum, apricot, almond and prune are identical. Whether the disease upon the other trees mentioned is really the same or merely closely related, is uncertain, although the experiments so far made seem to indicate the non-identity of the diseases. On account of their similarity, however, they have all been grouped together in general writing, most commonly under the name of "crown gall," although other names, such as the "black knot," "root knot," "root galls," and "stem and root tumors" have been applied.

As the disease is of very wide distribution, it has been written about extensively and in widely separated regions, and much speculation has been indulged in as to its real nature. Several writers have expressed themselves as believing that the disease can be conveyed from one tree to another, while other writers express precisely the contrary view. Only very recently was exact knowledge obtained through the careful investigations of Mr. J. W. Toumey, then of the Arizona Experiment Station. It is from his bulletin that the present account is largely drawn.

The disease is prevalent in twenty-two States, including such

distant ones as California, Texas, Florida, New Jersey and Michigan. It is presumably present wherever susceptible plants are raised. Since it is of such wide distribution, and numbers among its hosts so many economic plants its damage is very great, although the injury is frequently overlooked, since the part attacked is underground and beyond mere casual observation. Many trees die or live unprofitable lives owing to attacks of the crown gall, without the owner recognizing the cause of the malady.

Mr. Toumey states that a conservative estimate would place the loss in Arizona in one orchard alone as high as ten thousand dollars,



FIG. 13—Crown Gall.

and he considers that the loss to fruit growers in Arizona lies between \$40,000 and \$75,000 annually. Selby, in Ohio, states that in personal inspection of bundles of trees, he found in a lot of four hundred as many as twenty-four diseased trees, that is six per cent. One orchard in Lawrence County, containing 100 trees, purchased in New York, was grubbed out at seven years of age without having borne a single profitable crop. These trees were badly affected when delivered, and were nearly all diseased at the time of removal. One lot consisting of 1,500 trees, purchased in 1895, showed upon examination in 1897 that about 50 per cent were affected with the crown gall. The trees do not necessarily die, but they do worse, they live year after year and encumber the ground without returning profit.

For an accurate recognition of the disease the following description, translated by Mr. Toumey from Sorauer, is given: "The

swellings appear generally at the crown of the roots of young trees, the enlargements having the size of hazelnuts or walnuts. In older specimens they may attain the size of one's fist. When they appear upon nursery stock, they are usually limited to the crown, but occasionally are found deeper in the earth, or even upon slender one-year-old roots. The color of the gall, is similar in its younger stages to that of the sound root. Later a darker color appears, in consequence of a deposit of dead matter, which forms the bark of the gall. If one examines the galls occurring upon the smaller roots, it will be seen that they are generally located upon one side of the root body. They have a softer tissue than the root, but their color within is normal. The large galls are a series of hemispherical growths, superposed upon each other, so that the surface has an irregular or warty appearance. In the spring the more prominent of these elevations have a light-brown appearance and a perfectly herbaceous consistency. In cross sections the galls show an irregular fibrous mass."

As early as 1895, Dr. Halstead, by planting peach pits in soil with minced peach galls found that such seedlings were more badly infested than seedlings grown in soil devoid of the minced gall.

Selby, by a similar experiment, arrives at the same result. More recently Mr. Toumey has proved conclusively that the gall may be inoculated from tree to tree. In one of his experiments, he made inoculations on 20 seedlings, and in every case bad galls developed at the place where the incisions were made. Further than this, he has proved definitely that the disease is due to a fungus which grows within the cells, causing hypertrophy of the tissue. The fungus is somewhat similar in its parasitic habits to that fungus which causes the club-root of the cabbage. It grows in the tissue and eventually fructifies, producing spores which serve to spread the disease.

That the disease does naturally spread from tree to tree is only too evident from field observation. Mr. Toumey mentions one orchard in Glendale where a small per cent of the trees had galls upon them when planted, yet at the expiration of eight years less than one per cent remained unaffected. The spores from the old decaying galls are conveyed to the soil and thence to the new tissue, the spread being effected largely by cultivating tools. Any break in the bark near the ground gives better foothold for the establishment of the enemy.

*Treatment.*—Diseased trees should be taken up and burned. A gall either above or below the surface of the ground is a constant menace to healthy trees. Little can be done in the way of soil treatment to prevent the spread of the disease. The best procedure is to examine the orchard yearly, cut the galls from the crown, and cover the wounds with a blue-stone-copperas-lime paste, which will prevent re-infection.



Of course the greatest care should be exercised that no diseased trees be introduced into your orchard, and that you purchase only from nurseries which are free from the crown gall. If you receive a bundle having any galled trees, reject the whole lot, as those which do not show the disease may be already inoculated and in an incipient state.

#### FROSTY MILDEW.

(*Cercospora.*)

In damp, shaded localities a disease sometimes occurs on the peach, producing small, pale yellowish leaf spots. These show on the underside a delicate frost-like appearance, due to the growth of spore-bearing hyphae. It is not usually seriously abundant, and the treatments recommended for the other diseases will suffice to also hold this disease in check.

#### THE FRUIT SCAB OR THE BLACK SPOT.

(*Cladosporium.*)

This very common disease may consist of isolated sooty black specks, or of black specks so numerous as to coalesce into large blotches, which may sometimes cover as much as one-third or one-half of the peach. The side which is attacked will be dwarfed, often cracked, and the flesh adjacent to the diseased peaches remains bitter and green, even after the normal portions are ripe.

This spot is due to the growth of a fungus which probably winters on the branches of the tree. Winter spraying, such as is recommended for the peach curl, will kill these winter spores and reduce summer infection.

The disease develops to a more serious extent during rainy seasons, sometimes doing damage equal to 70 per cent of the value of the crop. Selby, of Ohio, estimates the loss in one crop that came under his observation at from 20 to 50 per cent. The scab, when bad upon the tree one year, is very liable to appear upon the same tree during following years. It is therefore advisable to spray infested trees, since the condition points to an almost certain reinfection in the following year.

#### THE PUSTULAR SPOT.

(*Helminthosporium.*)

This is a comparatively new disease, and is worthy of note from the fact that its spread should be recorded. The diseased peaches are described by Selby as "Badly disfigured, having numerous pimply red spots with light-brown centers." The peach, seen in an earlier condition of the disease, shows small, rusty-brown spots upon

the upper side. These increase in size and develop light-brown centers about one twenty-fifth to one twelfth of an inch in diameter. Upon yellow varieties the pustule is commonly lacking, there being but a light-brown center with a red border.

As the fungus which causes this spot rests purely upon the surface, development is prevented by spraying. Selby reduced the injury from 16 per cent to 1 per cent by using three applications of the Bordeaux mixture.

#### SHOT HOLE.

Many times in the peach orchard leaves are seen, more or less abundant, which appear as though perforated by shot. This is caused by the dropping out of a small area of the leaf tissue, owing to attack by fungi. Various fungi have been reported as capable of causing this appearance. Likewise poisoning by the use of Bordeaux mixture carrying too much copperas will cause this effect. The remedies already given are sufficient for this trouble.

#### THE BROWN ROT OR MOLD.

(*Monilia*.)

No other disease is probably so destructive to peaches, plums and cherries as is the brown rot, which attacks the fruits as they mature, turning them brownish in color, soft in texture, and useless in quality.

While this disease is most conspicuous in its damage to the fruits above mentioned, it also occurs to a greater or less extent on apples, pears and quinces. Aside from being present on the mature fruit, it also attacks the flowers and twigs. Its characteristic appearance on the fruit enables one to recognize it easily. It first appears as a small circular decayed spot. This spot rapidly enlarges until it embraces the whole fruit, at the same time shrinking it slightly. The diseased areas are brownish in color. As the decay advances, small tufts of threads appear in the center of the original spot, and rapidly spread, until the whole fruit becomes involved.

If the fruit hang in clusters, adjacent fruits will begin to decay at the points of contact, and the disease will spread from fruit to fruit until the whole cluster is lost. Nor does the damage end here. Fruit after it is picked may succumb to the attack, and peaches that were apparently sound at picking may be seriously damaged when they reach the end of their journey to market. Thus the loss falls upon both the grower, dealer and consumer. The advance of the decay in the peach is so rapid that infection to-day may mean a totally unsalable peach two days hence.

Peaches diseased on the tree may fall to the ground, or persist on the tree where they shrivel up and remain hanging over winter. They

then constitute the "mummy" peaches so familiar in infected orchards.

Upon the blossom the disease becomes first evident as a slight brownish discoloration which, as in the case of the fruit, spreads rap-



FIG. 14—Peaches molding on tree.



FIG. 15—Mummy peaches hanging on tree in winter.

idly, causing the flower to wither and eventually fall off as a rotten mass, carrying contagion to everything in its path. From the flower the rot may spread to adjacent twigs, through the flower stalk. Infection of the twigs may also occur directly from diseased fruit. From repeated observations it seems probable that the branches can not be infected through their unbroken skin, or if so only rarely. Dr. Smith states that the examination of hundreds of twigs in all stages of disease showed that every one was associated with blighted and persistent flowers. In the majority of cases the entire twig was killed.

Estimates as to the damage caused by this disease are unnecessary, since a glance into any peach basket on the market will convince any one of its great extent. We may mention, however, that its in-



roads are so serious that many of the peach and plum growers in this State will be obliged to secure a remedy for this pest or abandon the industry.

As with many other plant diseases, the cause is a microscopic fungus, which grows within the tissue of the fruit or twig, producing chemicals there which dissolve and discolor the tissue. After the fungous threads grow until they have partially exhausted the nourishment in the tissue, they send minute branches out through the surface, and produce the small tufts which are characteristic of the latest stages of the mold. These tufts bear the spores or reproductive organs in enormous quantity, and every breath of wind or splashing drop of water throws spores into the air to be blown to new fields of destruction.

Many people are inclined to regard the rot as inevitable, and as representing the normal condition of things. This rot, however, is due to a fungus, and if the spores of this fungus can be kept off, the rot can not develop. It is, however, to be noted that damp, "muggy" weather is just the kind which is most favorable to the rapid development and growth of the fungus. Cold storage or poisonous chemicals may prevent or retard this growth. Years in which there is full fruitage, accompanied by damp, warm weather, are almost certain to bring a severe attack of the rot; but it must be remembered that it is not the weather which directly causes the rot, but that it is the fungus which causes the rot, and the weather gives the proper condition for the development of the fungus. Otherwise there would be no hope, since we can not control the weather.

Experiments have been made in many States for the prevention of this most serious enemy of the drupaceous fruits. Some of the experiments have given the most flattering results, while others have been attended with almost total failure. It must be said that as yet we can not be confident of totally preventing the damage, yet we have great hope that we can largely control it, and that the near future will see decided advances in the methods of treatment.

The accompanying illustrations, taken from a South Carolina Experiment Station bulletin, show the results obtained there. These results were gotten by the use of Bordeaux mixture, spraying first just before the buds open, second when the fruit is well set, third about two weeks later and fourth when the fruit begins to color. In the first spraying they advise the use of Bordeaux mixture made of six pounds of copper sulphate, six pounds of lime, and 45 gallons of water. In any applications later than the first, the copper sulphate is reduced to  $2\frac{1}{2}$  pounds and the lime to 5 pounds.

They estimate the cost of four applications at from 12 to 13 cents per tree. At the Delaware Experiment Station the cost of six ap-

plications is estimated at 12 cents per tree, including labor and materials, while in Georgia it is estimated that one can spray four times for six cents. The tree, of course, should never be sprayed while in bloom, since this would destroy the power of fruiting.

Thoroughness should be the chief point. Every twig and leaf should be wet with the spray, yet it should not be so wet as to drip. If the orchard is sprayed one day, and the rain washes this spraying off, spray again as soon as possible. A thin coating of Bordeaux mixture should be kept on the fruit until the ripening period, and if washed off it must be replaced. Rainy weather is the most favorable weather to the development of the fungus, therefore spraying should be neglected least of all at this time.

All agree that every diseased piece of tissue in the orchard may carry over spores to the following year, therefore you should go through your orchard and remove and burn all dead twigs and decayed fruits as soon as possible. After burning all trash, a winter spraying to destroy all spores wintering on the bark will pay. This application should consist of copper sulphate, 1 pound, and water, 25 gallons, or strong Bordeaux mixture may be used. Apply this spray from one to three weeks before the buds open. This will also prevent the peach curl. The copper sulphate of the Bordeaux mixture is injurious to peach foliage, but the results at the South Carolina Experiment Station seems to indicate that  $2\frac{1}{2}$  pounds may be used with safety in forty-five gallons of water with five pounds of lime.

The benefits of spraying reach much farther than to merely increase the harvest from the tree, since spraying the tree increases very materially the keeping quality of the fruit. This was illustrated in a test made by the Georgia Experiment Station, as follows:

"July 5, a basket of apparently perfectly sound peaches was gathered from each of two trees of Heusted's No. 53, one tree having received two applications of Bordeaux mixture, the other tree being unsprayed. These two baskets were placed side by side on a shelf in the laboratory. Forty-one hours later it was determined by count that three-fourths of the peaches from the unsprayed tree were more or less rotten, while the fruit from the sprayed tree was perfect. July 9, all of the peaches from the unsprayed tree quite rotten, and sprayed fruit perfect. July 10, sprayed peaches still perfect.

"On same day, July 5, a basket of Carman peaches was gathered from each of a sprayed and unsprayed tree. July 7, about fifty per cent of peaches from unsprayed tree rotting, while fruit from sprayed tree perfect. July 10, all peaches from unsprayed tree are quite rotten and sprayed fruit with three peaches showing rot. July 12, peaches from sprayed trees now rather badly rotten.

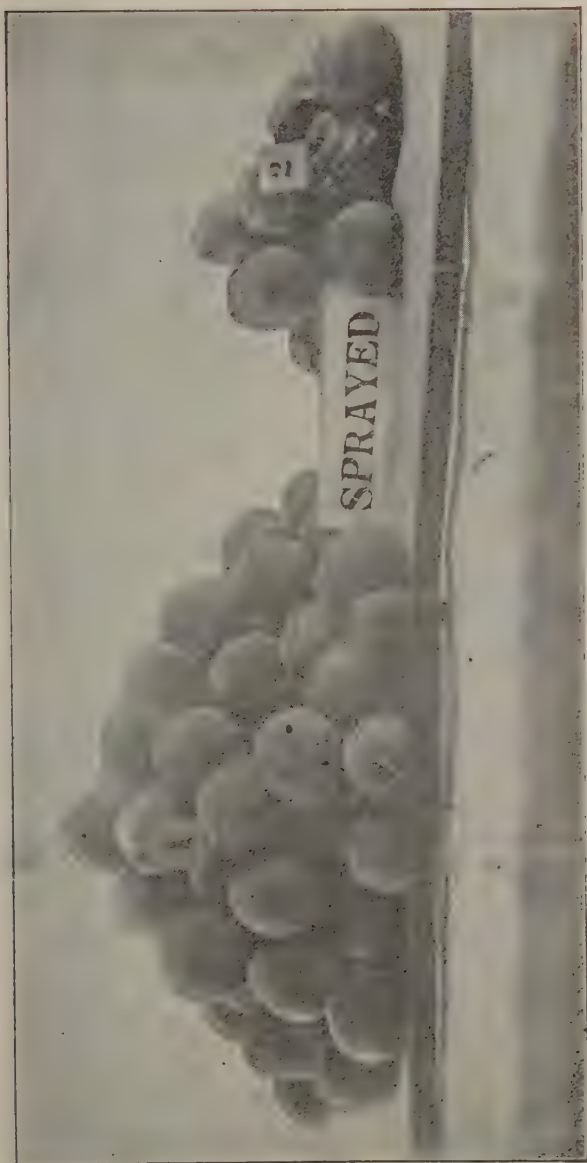


FIG. 16.—Fruit from sprayed trees. (1) Sound fruit. (2) Rotten fruit.



FIG. 17.—Fruit from a tree not sprayed (1) Sound fruit (2) Rotten fruit.



"Practically the same test of keeping qualities of fruit from sprayed and unsprayed trees was made with early Michigan, Champion, Heusted's Extra Early (No. 16), and Heusted's No. 54, with the results that peaches from sprayed trees have kept from three to five days longer than peaches from unsprayed trees."

There is objection to applying the Bordeaux mixture after the peach begins to ripen, inasmuch as it may adhere and cause unsightly spots, which, while in reality perfectly harmless, injure the selling value of the fruit. To avoid this, various substitutes have been tried; foremost among these are two, namely, copper acetate (dibasic acetate of copper), and potassium sulphide. The results from some stations seem favorable to the use of these, while other experiments are not so promising. The final word regarding either of these substances can not yet be said. As a result of experiments the Georgia Experiment Station, recommends discontinuing the Bordeaux mixture after the fruit has begun to color, and substituting copper acetate, at the rate of six ounces of copper acetate to fifty gallons of water. Dissolve the copper acetate by stirring and apply with a spray pump. This substitution should be made three or four weeks before the peaches are to be picked. The California Experiment Station, with regard to the same mold on the olive, makes a similar recommendation. Dr. Sturgis, of the Connecticut Experiment Station, finds that the acetate of copper, in its ordinary form, that is the subacetate or verdeggris, can not be used, since it injures the foliage, but that the normal copper acetate is harmless and is effective as a fungicide. The difficulty of securing this normal acetate, however, precludes its general use. Dr. Sturgis experimented with potassium sulphide, and found a solution of one pound to fifty gallons of water most favorable. He noted no injurious effect from this, and when the solution was used very thoroughly he found an increase of almost 20 per cent in the yield of perfect fruit.

Summing up the experience of all of the people who have sought to prevent the mold of the peach, the following recommendations are made:

1. Clean and burn all decayed fruit or diseased twigs.
2. Spray with a strong Bordeaux (5-5-50) or copper sulphate solution (1 pound to 18 gallons) before the buds expand.
3. Just before the blossoms open spray with a weaker Bordeaux mixture ( $2\frac{1}{2}$ -4-50 or 3-6-50). Repeat this treatment every two weeks, or as often as need be to keep a coating on the fruit until it begins to color.
4. After the fruit begins to color, substitute either potassium sulphide, 1 pound to 50 gallons of water, or the copper acetate, 6 ounces to 50 gallons of water.

## THE PEACH YELLOWS AND THE PEACH ROSETTE.

These two diseases of the peach which are especially destructive in certain regions, are not yet known to occur to any dangerous extent in North Carolina. The statement is generally current that they do not exist here at all, but there are rumors of their occurrence, which while yet not fully substantiated are still worthy of tentative acceptance. The peculiar fact that these diseases are present on both sides of the State—the Yellows on the north and the Rosette on the south, emphasizes the necessity and importance of being forewarned as to their nature and character, and the possibility of invasion, so that the peach-grower may recognize any attack in its development.

## PEACH YELLOWS.

The peach yellow has been known in the United States something like one hundred years. It seems to have first spread from a centre, somewhere in the neighborhood of Philadelphia, and is now quite general through Pennsylvania, Maryland, Delaware, New Jersey, Massachusetts, Rhode Island, Connecticut, and through portions of New York, Michigan, Indiana, Ohio, Illinois, Northern Kentucky, West Virginia and Virginia. It is extending its frontier in every direction.

The disease is of unknown cause, but it has been absolutely and positively proved that it is contagious, that can be conveyed from tree to tree. *The tree must therefore be cut and burned.* Cutting the trees and allowing them to lie in the orchard is as bad as leaving them standing. The roots, however, do not infect the soil, and a tree may be safely planted in the identical spot from which a diseased tree has been removed.

These facts should enable the peach growers of this State to completely eradicate the small amount of disease now here, and prevent its encroachment upon our land.

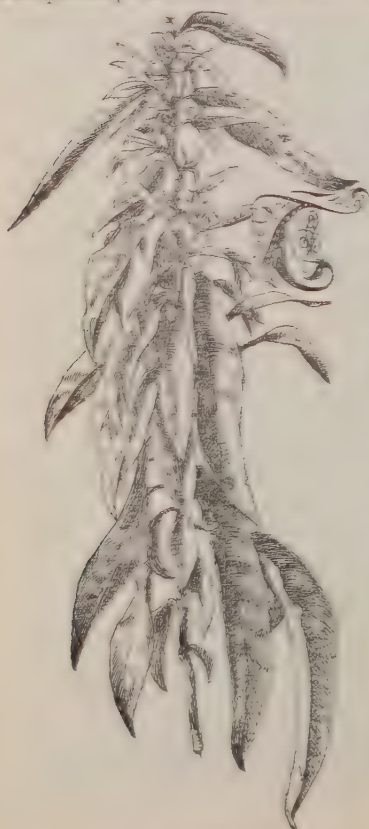


FIG. 6.—An affected twig.

It is easy to recognize this disease, as it has marks which leave no uncertainty as to its identity. They are given in the words of Dr. Smith as follows:

*"Prematurely ripe, red-spotted fruits, and premature unfolding of the leaf buds into slender, pale shoots, or into branched, broom-like growths, are the most characteristic symptoms of yellows. The time of ripening of premature fruits varies within wide limits; sometimes it precedes the normal ripening by only a few days, and at other times by several weeks. The red spots occur in the flesh*

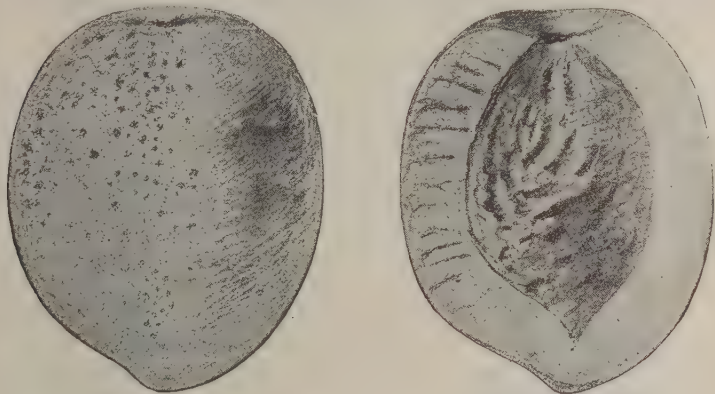


FIG 9—A peach affected with yellows, showing spots on the surface, also a sectional view showing the diseased interior.

as well as on the skin (see Fig. 9), making the peach more highly colored than is natural. The taste of the fruit is generally inferior and often insipid, mawkish or bitter. Often this premature ripening is the first symptom of yellows. The peaches are then of good size and quite showy, and occur on trees in full vigor, upon limbs bearing abundant green foliage and sometimes also other fruits which afterwards ripen normally.

Often during the first year of the disease this kind of fruit is restricted to certain limbs, or even to single twigs, which, however, do not differ in appearance from other limbs of the tree. The following year a larger part of the tree becomes affected, and finally the whole of it, the parts first attacked now showing additional symptoms, if they have not already done so. These symptoms are the development of the winter buds out of their proper season. Like the maturing of the fruit, the date of this also varies within wide limits. The buds may push into shoots only a few days in advance of the proper time in the spring, or may begin to grow in early summer, soon after they are formed, and while the leaves on the parent stem are still bright green. This is a very common and characteristic symptom, and is especially noticeable in autumn when

the normal foliage has fallen. Usually under the influence of this disease feeble shoots also appear in considerable numbers on the trunk and main limbs. These arise from old resting buds, which are buried deep in the bark and wood, and remain dormant in healthy trees. Such shoots are sometimes unbranched and nearly colorless, but the majority are green and repeatedly branched, making a sort of broom-like, erect, pale-green, slender growth, filling the interior of the tree."

*Treatment.*—Any tree exhibiting these symptoms must be cut and burned. It is valueless, and its presence is a serious menace to the owner and to the State.

#### PEACH ROSETTE.

The peach rosette is Southern in distribution, being known principally in Georgia, South Carolina and Kansas. It may possibly encroach upon our State, and growers should be forewarned regarding its character. As to its nature, means of spreading, and means of prevention, precisely what has been said of the yellows applies. Its distinguishing characters are given by Prof. Smith as follows:



FIG. 10.—A single Peach Rosette.

(From Smith, U. S. Department of Agriculture.)

"Rosette clearly belongs to the same type of disease as yellows, but its first stages are more striking and its progress is much more rapid. It may first attack part of the tree and then the remainder, the same as the yellows, but it is more likely to appear at once on the whole tree, and generally in early spring. In trees attacked in this manner, all of the leaf buds grow into compact tufts or rosettes. These rosettes, though seldom more than two or three inches long, usually contain several hundred small leaves. One rosette is shown in Fig. 10. A tree thus attacked always dies during the following winter or autumn. When part of a tree is thus attacked, that part dies as



above described, and the remainder shows symptoms the next spring, to die in turn after about six months.

"The prevailing color of the foliage is yellowish green or olivaceous. The older leaves at the base of the tufts are largest and frequently grow to a length of several inches, but have inrolled margins and a peculiar stiff appearance, due to the fact that they are straighter than healthy leaves. These outer leaves turn yellow in early summer, and drop as readily as though it were autumn, while the inner leaves of the rosette are still green and delicate. The compact bunching of the leaves is very conspicuous, and makes the trees look quite unlike those affected by yellows. Where a tree is attacked in all parts it matures no fruit. In all the cases which have been noticed, the fruit borne by affected trees either shrivels while green and drops off, or else ripens naturally. No premature peaches have been seen in Georgia, except such as were due to the girdling of the trunk by borers.

"In the absence of premature, red-spotted fruit, in the severity of the disease from the outset, and in its rapid progress, it is quite unlike yellows, which is decidedly chronic, and the first slight symptoms of which usually occur in very green and thrifty trees, and are frequently overlooked the first season."

*Treatment.*—Cut and burn. No carelessness should be tolerated regarding either of these diseases, which have not yet gained foot-hold in the State, and which may be kept in complete subjugation by proper watchfulness and care.

## b. FUNGUS DISEASES OF THE PLUM.

### THE PLUM SPOT.

(*Cladosporium.*)

The plum scab causes spotting of the fruit similar to the scab of peaches. "When plums begin to ripen or are just turning in color, small round patches not larger than a pin head make their appearance. They are pale greenish or grayish in color. These spots increase in size until in some cases they are half an inch across. They are usually round, with a border somewhat paler than the inside. In older specimens the patches are frequently confluent and of darker brown color. In very old specimens, especially in those where the fruit has undergone decomposition, the patches become black and uneven.

"An examination of the small grayish spots shows a nearly colorless mycelium creeping over the surface. In the darker portions of the large patches are septate hyphae."

This disease is very close kin to the scab of the peach, and it is unnecessary to discuss it separately here. Treatment the same as that recommended for the peach will apply in this case.

## THE LEAF CURL.

*(Exoascus.)*

This disease is very similar to the peach curl, and seems completely amenable to treatment with the Bordeaux mixture. (See Peach Curl in this bulletin.)

## THE LEAF SPOT.

*(Cylindrosporium.)*

The leaf-spot or shot-hole disease attacks plums and cherries, causing a portion of the leaf tissue to become discolored, the spot often bearing a red or purple border. If abundant, several spots may coalesce as they advance in maturity. The tissue involved dies, turns brown, and often drops from the leaf, leaving circular or ragged holes. This character gives rise to the common name, "shot-hole disease."

The attack is very insidious, and the disease often does much damage before its presence is really known. The chief injury is through defoliation, the leaves falling freely after the attack of the fungus. This defoliation checks the starch-producing power of the tree, and this in turn impairs the tree's general vigor and productiveness, even weakening the tree to such an extent that it can not withstand the winter.

The disease is especially injurious to nursery stock, as it may interfere with successful budding and grafting. The following recommendation in the way of treatment is made by the New York Experiment Station:

1. Apply the Bordeaux mixture about ten days after the blossoms fall.
2. About three weeks later repeat this treatment.
3. About four weeks later repeat again.

In one instance in the New York Station, "The treatment resulted in an average increase per tree of twenty-four and one-half pounds of marketable fruit, at an estimated cost of less than one cent per pound. The average yield per tree of picked fruit was increased 44 per cent, the marketable drops increased 8 per cent, and the waste was decreased 81 per cent. The total yield of marketable fruit as recorded in pounds was 45 per cent greater when the trees were sprayed than when they were not sprayed."

## PLUM POCKETS.

*(Exoascus.)*

The name *plum pocket*, or *plum bladder*, arises from the curious hollow deformity of the plum, caused by the fungus *Exoascus*. The pulp of the fruit is replaced by a thin, puffed-up shell, and in the place of the seed merely a hollow cavity exists.

The disease appears soon after the flowers fall, and the affected fruits drop from the tree. The diseased fruits vary in size from one to two inches in length, and can be readily distinguished from the healthy fruit by their pale, yellow color. As they age, they become coated over on the outside with a fine powder. This powdery coating consists, in reality, of multitudes of spores produced by the fungus within, which has caused the malformation of the fruit. Later the pockets turn black and fall.

The disease is local in character, rarely attaining the prominence of an epidemic. A single tree in an orchard may bear the "pockets," sometimes every fruit on the tree being affected, while surrounding trees are normal. A tree once affected continues to bear pockets in succeeding years. Treatment may consist in cutting and burning affected branches or trees.

#### THE RUST.

(*Puccinia*.)

The rust of the plum is very closely allied to the rust of the peach, and the reader is referred to the article in this bulletin on the peach rust for information regarding this disease.

#### THE BLIGHT.

(*Bacillus*.)

The blight of the apple and pear have been discussed in bulletin No. 183.

A very similar blight is rarely known to affect the plum tree. Recently exceedingly careful studies have been made which make it almost certain that the disease of the plum and pear are identical. Germs or tissue taken from the diseased plum tree and inoculated into the pear promptly produced the familiar pear blight, and microscopic examination showed that the germs of both blights have the same appearance.

While the plum blight is exceedingly rare, it is important that fruit growers should know that the disease is identical with the pear blight, as this knowledge will of course help very materially in fighting the disease.

The remedy is the same as that recommended for the apple and pear, namely, to cut out and burn all affected branches. (See Bulletin 183, page 66.)

#### THE PLUM YELLOWS.

(See peach in this bulletin.)

#### THE MOLD OR BROWN ROT.

(*Monilia*.)

(See peach in this bulletin.)



## BLACK KNOT.

*(Plowrightia.)*

The black knot receives its name from the swollen black distortions on the branches. In its earliest conditions the knot is merely a swelling of the twig; as the swelling proceeds, the bark cracks, and from these cracks come forth fungus threads which cover the surface of the twigs, and eventually bear great quantities of spores. These spores, carried by the wind or water, reach the surface of other young shoots, and there originate new swellings. In a young condition, the galls are olivaceous, but as the season advances they become darker and eventually coal black. At the same time the texture changes from juicy to hard and brittle. It is in this hard brittle knot that another kind of spore, the winter spore, is borne. These serve also to spread the contagion, but at another time of the year. It will be seen that the fungus has two, and if the whole story were told it has more than two, methods of spreading from tree to tree, and consequently it is a very destructive pest. Moreover, it grows upon all kinds of plums and nearly all cherries, and is therefore very widely distributed.

Occasionally, when the swelling becomes old, insects take refuge in it, and for this reason some observers have thought that the insects cause the gall; this, however, is not true. The insects come only after the gall is formed. The fungus actually causes the gall.

When the disease extends all of the way around the twig, the supply of nourishment to more distant parts is seriously interfered with. If less than the whole of the circumference be involved, the damage, of course, is not so great, but it is even then great enough to very seriously impair the fruiting power of the tree. The knots may completely kill the tree in a year or two, or they may be only abundant enough to destroy the value of the tree.

It seems probable that the spores can cause infection only when they fall upon injured bark, that is, the fungus can not enter through perfectly healthy bark. One step towards lessening the disease is therefore to exercise all care to not bruise the tree.

Effective measures, however, must consist of pruning out and burning all black knots. If pruned out and left in the orchard, the fungus continues to grow, to produce spores, and to cause infection. The knots must be burned. Cutting out and burning diseased twigs, if followed thoroughly, will remove all danger. Experiments show that the Bordeaux mixture will very materially lessen the spread of the black knot, and while it might not pay to spray to prevent this disease, spraying in an orchard for other reasons will really lessen the danger from the black knot.



## THE POWDERY MILDEW.

*(Podospheeria.)*

(See cherry in this bulletin.)

## c. FUNGUS DISEASES OF THE CHERRY.

## POWDERY MILDEW.

*(Podospheeria.)*

The mildew described in another bulletin in connection with the diseases of the apple, sometimes does considerable damage to the plum and cherry, especially on nursery stock where the growth of the mildew prevents either the growth of the seedling or successful budding and grafting. This mildew is a fungus. In the summer it produces white spots on the surface of the leaves, and in these spots millions of spores develop. These spores are spread by wind and water, and carry the infection to neighboring trees. Another kind of spore is produced as fall approaches, to carry the disease over winter.

The fungus grows on the exterior of the leaf, but sends minute root-like suckers into the tissue to suck up nourishment. The affected patches are circular in outline, because they originate from a central infection and thence spread with equal rapidity in every direction. On old leaves the disease is not of great damage, but when the attack is made on young growing tips, or on young leaves, these delicate structures suffer greatly from the loss of the nourishment stolen from them.

Contrary to the nature of most fungi, these mildews live and grow best during fair, dry weather. A light rain which will spread the spores and furnish moisture enough to allow them to germinate, followed by a dry spell, best favors the growth of the fungus.

The fungus rests on the outside of the leaf, thus furnishing one of the few cases in which cure rather than prevention is possible, although of course the old adage is ever true. To hold this disease in check, the use of the Bordeaux mixture has proved very satisfactory. Apply it about every ten days during the early growing season, and more frequently if necessary to replace any poison washed off by the rain.

LEAF SPOT (*cyindrosporium*)—(see plum in this bulletin).

RUST (*puccinia*)—(see peach in this bulletin).

BLACK KNOT (*plowrightia*)—(see plum in this bulletin).

## THE MOLD OR BROWN ROT.

*(Monilia.)*

The same fungus which produces such disastrous results upon

the peach also causes a mold or rot on the cherry. Inasmuch as the fungus is identical with that of the peach rot, its treatment is the same, and it is not necessary to discuss it further here. (See Peach in this bulletin.)

THE CURL.

(*Exoascus.*)

The cherry curl is due to a fungus closely related to that of the peach curl. The leaves become wrinkled before they are full size, and the spores are produced on the surface of the leaf, as they are in other "curls." The disease is not common in America. Should it become so, it can be held in check by pruning out the diseased twigs.

THE CHERRY SCAB.

(*Cladosporium.*)

(See scab of plum and peach in this bulletin.)

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d. FUNGUS DISEASES OF THE PERSIMMON AND FIG.

While several diseases are known to affect these fruits no particular attention has yet been given to them, owing to the slight commercial importance of the fruits in question in this State. Several of the diseases of the persimmon and fig are undoubtedly identical with similar diseases of the fruits mentioned in previous pages of this bulletin, and the treatments recommended here will probably prove useful with these fruits. Any persons suffering from injury by disease to the persimmon or fig are requested to send to the Experiment Station the diseased leaves, twigs or fruits, that a study of the same may be undertaken.